come into being at these times, or are completely absorbed at times of greater general brightness of the star, neither of them being accounted for by the greater contrast of a feebler continuous spectrum; for at Hζ the continuous spectrum was never so bright as the CN band, and the blue band is not a previously existing band grown stronger, but it occupies the space between two previous bright bands, in the same manner as the CN band occupies the space between Hζ and Hη.

The dates on which this spectrum has appeared are indicated by the brackets in the following list, and may be called the minimum type: February 28, March 3, 7, 8, 12, 16, 17, 20, 21 (22), (25), 27 (28), April 1, 4, 5, 9 ? (11), (12), (13), (16), 19 (20), (21), 23 (25), (26). On the other dates not in brackets the CN band is completely absent, and the blue band 4633 is replaced by a pair of bands, one on each side of its position. And it is noteworthy that the pair of bands appeared for the first time on March 21, the day before the first photograph of the minimum type spectrum. They had formed from a very broad bright band covering about 5 μμ, which had been a constant feature of the spectrum from February 28 to March 20.

The query written against April 9 in the above list of dates signifies uncertainty of the type of spectrum on that date. It seems to be in the state of transition from the non-minimum type to that of the minimum, or *vice versa*; the CN band is absent, but the blue band 4633 is present in a diffusive state, and not strong, and without its otherwise constant companion at 4681.

The radiant energy of the CN band seems to be very great. On the later dates, notwithstanding the low altitude of the star and the sensibility curve of the plate, it is stronger than Hδ. At the same time a remarkable change appears in the relative strengths of Hε and Hδ. On the spectrographs of April 16, 20, 25, and 26, Hε is stronger than Hδ, and the CN band is stronger than Hε; so that the relative intensities of these three bands are in the inverse order of the sensibility curve, and the relation is not exaggerated by expressing the density of the silver deposit at Hδ by *d*, and writing 2*d* and 3*d* for the densities at Hε and the CN band.

Stonyhurst College Observatory:
1901 *May* 5.

The Visual Spectrum of Nova Persei.

By the Rev. A. L. Cortie, S.J.

The following observations of the visual spectrum of *Nova Persei* were taken by means of an equatorially mounted refracting telescope with an excellent 5-inch object glass by Alvan Clarke, but without clockwork, and a McClean eyepiece star spectroscope of small dispersion. The estimates of the magnitude of the star during the times of the observations, after the star

became invisible to the naked eye, were made in the small finder of the instrument by Mr. Joseph Ronchetti. The observation of the star's spectrum on April 21 is also due to the same observer, and he assisted in all the other observations. The wave-lengths of the lines, which are given to three figures, do not pretend to any degree of exactness, but may be a guide to the identification of those lines the origin of which was not at once evident. They were derived by a comparison of eye estimates with the photographs of Father Sidgreaves, and that taken on February 28 by Professor Hale, and published in the Yerkes Observatory Bulletin No. 16. By this means it was quite easy to fix the approximate mean wave-lengths of the bright and dark bands observed in the small instrument employed. The details of the observations are as follows.

On the three nights, March 12, 16, 20, the predominant lines were the hydrogen lines α, β, and γ, the first two being very brilliant, a bright yellow line, presumably D, and a bright triplet in the green comprising the b group, and bands at λ 500 and λ 550. On the 12th a broad dark absorption band, slightly more refrangible than D, was seen, identified by Professor Hale (*loc. cit.*) as corresponding to D_3.

On these three nights the magnitude of the star during the times of observation between the hours of 9 and 11 P.M. was estimated as equal to δ, between ν and κ, and equal to ν—or 3, nearly 4, and 4. The colour on the 12th and 16th was noted as very like that of the planet *Mars*.

On the 21st the magnitude of the star was estimated as slightly less than ν, or fourth magnitude. The night was perfect for seeing, and no less than sixteen bright and dark bands and lines were observed. Of these, nine were bright lines, Hα, Hβ, D, b, λ 500, λ 466, a band still more refrangible, and two others in the red, the one less and the other more refrangible than Hα. The former of these is very probably the line λ 6678 due to helium, and so frequently observed in company with D_3 in solar prominences. It was again seen on March 28, when the star had fallen to the sixth magnitude. The same line is represented in the drawing of the visual spectrum of *Nova Aurigæ* made by Professor Campbell at the Lick Observatory on 1892 February 28.

The other very faint and fine bright line likewise seen in the red was estimated at one-third of the distance between C and D, somewhere about λ 640. This line was again seen on the 25th, was invisible on the 27th, and reappeared on the 28th, thus becoming visible when the star fell in magnitude to 6, and disappearing with the intermediate rise of the star to the fourth magnitude.

Of the other bright lines the b group and λ 500 were as broad but not so brilliant as Hβ; Hα and D were bright, while λ 466 first forced itself upon notice on this night. It has since remained a prominent member of the bright line series.

The seven dark spaces comprised more refrangible companions to Hα and Hβ, dark D_3, and dark spaces in the green less refrangible than *b*, λ 500, and Hβ. The remaining dark space intervened between λ 466 and Hγ. Their mean wave-lengths would be approximately λ 540, λ 510, λ 498, and λ 445. Of these, λ 510 and λ 498 were the most marked. There was also continuous spectrum in the region from D to λ 540, in which, however, no details could be made out with certainty.

On March 25 the star was just visible to the naked eye, being estimated as equal to *l*, or 32 of Cottam's charts, which is of magnitude 6. The bright lines seen were Hα, the line in the red about λ 640, D, *b*, λ 500, Hβ, λ 466; a wonderful spectrum for visually so small a star. The dark spaces were λ 540, λ 510, λ 498, which was between two and three times as broad as Hβ, and the dark space more refrangible than Hβ about λ 480, which, too, was very broad. The spectrum in its main details was not unlike that of March 21, except that it was less brilliant. Hα, however, and the bright space at λ 466 were quite as bright as on the former date.

On March 27 the star's magnitude had risen again to nearly 4, when first observed at 9.30, though at 10 P.M. it had sunk about half a magnitude. The bright lines seen were Hα, now the brightest of all; D, not so bright as on the 25th; *b*, only glimpsed; λ 500, well seen; Hβ, not very brilliant and seemingly diminished; λ 466, brighter and well seen; and Hγ. The dark companion to Hα was just visible, as was also dark D_3, and λ 498 and the companion to Hβ were seen.

On March 28 the star had again fallen to magnitude 6, and became even fainter during the course of the observations. The spectrum resembled that of the 25th, the luminosity having shifted to the red and orange. There was a very great increase in the brilliancy of the D line, and Hα was, too, very bright, equalling Hβ in intensity. The two faint lines, one on each side of Hα, first seen on March 21, were again visible. The *b* group was very faint and occasionally visible, but λ 500 almost equalled Hβ in brightness. Hβ, however, was less brilliant than on the 21st. The band λ 466 had increased in brightness, and Hγ was seen. The continuous spectrum in the green was still visible. The dark spaces λ 540, λ 510, and λ 498 were less marked.

On April 1 the magnitude of the star had again increased, being slightly above κ *Persei*, or 4·5 magnitude. Again, as on March 27, an increase in the magnitude of the star was accompanied by a diminution in the brilliancy of the D line; Hα was very bright, and its dark companion was seen. The *b* band was fainter, and was observed on this night for the last time. The band λ 466 was broader, and so, too, was the bright band still further to the violet, seen first on March 21. The dark spaces λ 510, λ 498, and λ 480 were present though not so distinct.

On April 16 the star was just on the limits of unaided vision,

being glimpsed a few times. It was estimated as less than 36 of Cottam's charts.

A great change had now taken place in the order of brilliancy of the lines, the order being λ 500, Hβ, λ 466, Hα, which was well seen at times, and D, seen only occasionally. Group *b* had disappeared, and the continuous spectrum in the green was of diminished lustre. The dark spaces λ 510, λ 498, and λ 480 were very prominent, partially, no doubt, due to contrast.

On April 19 *Nova* was invisible to the naked eye, and the observation was made through haze and fog. But λ 500 and Hβ seemed to be of equal intensity; D was seen once or twice distinctly, Hα and λ 466 only glimpsed.

On April 21 the magnitude was equal to that of *l Persei*, or 6. The order of brightness was λ 500, Hβ, λ 466, which equalled Hβ at its least refrangible side and faded away towards the violet, D, which was faint, and Hα glimpsed once. The dark space λ 498 was very dark, and λ 480 less so. The continuous spectrum in the green had much brightened.

On April 23 the star rose in magnitude a little above *l*, and the order of brightness in the lines changed to Hα, Hβ, λ 466, λ 500, D. The continuous spectrum in the green still maintained its brilliancy.

On April 24 the star was observed in a hazy sky, but still seemed greater than *l*. The brightest line was λ 500, which was very broad. Then came Hβ, Hα, λ 466, which was brightest at its red side, was very broad, and faded away towards its violet side, and D, seen rarely. The dark spaces λ 510, λ 498, were seen.

On April 25, with the magnitude less than *l*, the order of brightness in the lines of April 16 was resumed, λ 500 being most prominent. The continuous spectrum was weak.

On April 26, with the same magnitude and with perfect seeing, the same order was maintained, except that Hγ was also seen. The D line was excessively faint. Although the continuous spectrum in the green was not very bright, it was present, and details were glimpsed in it beyond the power of the instrument to define. The dark space λ 498 was very pronounced, while λ 510 and λ 480 were well seen.

The chief conclusions to be derived from these details are as follows:

(1) When the star waned on March 25 and 28, the D line and the lines observed in the red and yellow end of the spectrum became bright. On March 27 and April 1, when the star became brighter, D and this part of the spectrum became less brilliant.

(2) The similarity in the order of the brightness of the lines on April 16, 21, 24, 25, 26, is noticeable. But on April 23, the star becoming brighter than on the 21st, the spectrum altered and became almost exactly like that of April 1 and March 27.

(3) The band at about λ 466, first seen on March 21, seemed to be growing relatively brighter and broader, until it became

quite conspicuous on April 16, and remained so, being brighter and sharper at its less refrangible end and diffuse in the opposite direction.

(4) Hα was very bright on March 12, 16, 21; was equal in intensity to Hβ on the 25th; greater than it on the 27th, when it was the brightest of all the lines; equal to it on the 28th; greater than it on April 1; less on the 16th; faint on the 19th and 21st; greater yet again on the 23rd; then less on the 24th, 25th, and 26th, on which last date it was very faint.

(5) The line at about λ 500 on March 21 was not as bright as Hβ; on the 28th became equal to it, faded when the star rose in magnitude on April 1, became greater than it on the 16th, again equalled it on the 19th, became greater on the 21st, less on the 23rd, and the brightest of all the lines on the 24th, 25th, and 26th.

(6) The bright lines shown in this small instrument seem to be coincident with prominent chromospheric lines in the same region of the spectrum.

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Further Observations of the New Star in Perseus, made at the Radcliffe Observatory, Oxford.

(*Communicated by Arthur A. Rambaut, M.A., Sc.D., F.R.S., Radcliffe Observer.*)

This paper is a continuation of two others published in the last two numbers of the *Monthly Notices* (pp. 348 to 354 and 390 to 395). It contains the results of the observations of the magnitude and colour of *Nova Persei* made at the Radcliffe Observatory since the last meeting of the Society.

The estimates included in this paper have been chiefly made with telescopic aid, as encroaching twilight and the diminishing altitude of the *Nova* rendered naked-eye estimations increasingly difficult.

In this set of observations the number of comparison stars has been so limited that, to avoid the necessity of frequent reference to the previous papers, their names and index numbers have been set down in Table I. In cases where a telescope has been used an asterisk is affixed to the reference number.

Table II. contains the means of each observer's separate comparisons, and the general mean for each evening.

The accompanying diagram represents graphically the fluctuating changes in the brightness as evidenced by the Radcliffe observations, and is in continuation of a similar diagram printed on page 391 of the *Monthly Notices*. Upon examination of these